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**Plastics piping systems—
Glass-reinforced thermosetting
plastics (GRP) pipes—Determination
of initial specific ring stiffness**

ICS 23.040.20; 83.120; 83.140.30

Reference number : JIS K 7032 : 2002 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by the Japan Reinforced Plastics Society (JRPS)/the Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS K 7032 : 1998** is replaced with this Standard.

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Plastics piping systems—Glass-reinforced thermosetting plastics (GRP) pipes— Determination of initial specific ring stiffness

Introduction This Japanese Industrial Standard has been made based on ISO 7685 *Plastics piping systems—Glass-reinforced thermosetting plastics (GRP) pipes—Determination of initial specific ring stiffness* published in 1998 with modifying the technical contents.

The portions underlined with dots are the matters not including in the original International Standard. The list of modified matters with explanation is given in Annex.

1 Scope This Standard specifies methods for determining the initial specific ring stiffness of glass-reinforced thermosetting plastics (GRP) pipes and glass-reinforced thermosetting plastics mortar pipes. Three methods are given, and within the specified deflection limits each is equally valid and may be used for any diameter.

Remarks : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

ISO 7685 : 1998 *Plastics piping systems—Glass-reinforced thermosetting plastics (GRP) pipes—Determination of initial specific ring stiffness* (MOD)

2 Definitions For the purposes of this Standard, the following definitions apply:

2.1 compressive load (F) load applied to a pipe to cause a diametric deflection.

It is expressed in newtons.

2.2 vertical deflection (y) vertical change in diameter of a pipe in a horizontal position in response to a vertical compressive load (see 2.1).

It is expressed in metres.

2.3 relative vertical deflection (y/d_m) ratio of the vertical deflection y (see 2.2) to the mean diameter of the pipe d_m (see 2.4).

2.4 mean diameter (d_m) diameter of the circle corresponding with the middle of the pipe wall cross-section.

It is given, in metres, by either of the following equations:

$$d_m = d_i + e$$

$$d_m = d_e - e$$

where

d_i is the average of the measured internal diameters (see 5.3.3), in metres;

d_e is the average of the measured external diameters (see 5.3.3), in metres;

e is the average of the measured wall thicknesses of the pipe (see 5.3.2), in metres.

2.5 specific ring stiffness (S) a physical characteristic of the pipe, which is a measure of the resistance to ring deflection under external load.

This characteristic is determined by testing and is defined, in newtons per square metre, by the equation

$$S = \frac{E \times I}{d_m^3}$$

where

E is the apparent modulus of elasticity as determined in the ring stiffness test, in newtons per square metre;

I is the second moment of area in the longitudinal direction per metre length, expressed in metres to the fourth power per metre, i.e.

$$I = \frac{e^3}{12}$$

where

e is the wall thickness of the test piece, in metres;

d_m is the mean diameter (see 2.4) of the test piece, in metres.

2.6 initial specific ring stiffness (S_0) initial value of S obtained by testing in accordance with this Standard.

It is expressed in newtons per square metre.

3 Principle A length of pipe is loaded throughout its length to compress it diametrically. Three ways are given for doing this, method A (constant load) and method B (constant deflection) apply to the pipes of time dependency and method C applies to the pipes of little time dependency.

Method A: After applying the load necessary to give a relative deflection of $(3 \pm 0.5) \%$, the load is kept constant for a specified period of time and the final deflection is determined at the end of this period.

Method B: After applying the load necessary to give the initial relative deflection specified in the referring standard, the deflection is kept constant for a specified period of time and at the end of this period the final load being applied is determined.

Method C: After applying the load necessary to give the vertical deflection specified in the referring standard, the final load being applied is determined.

NOTE : It is assumed that the following test parameters are set by the standard making reference to this Standard.

- a) the method to be used (A, B or C);
- b) the length of the test pieces (see 5.1);
- c) the number of test pieces (see 5.2);
- d) if applicable, the details of conditioning of the test pieces (see clause 6);
- e) for method B, the relative deflection to be applied (see 7.3.3);
- f) for method C, the vertical deflection to be applied (see 7.3.4).

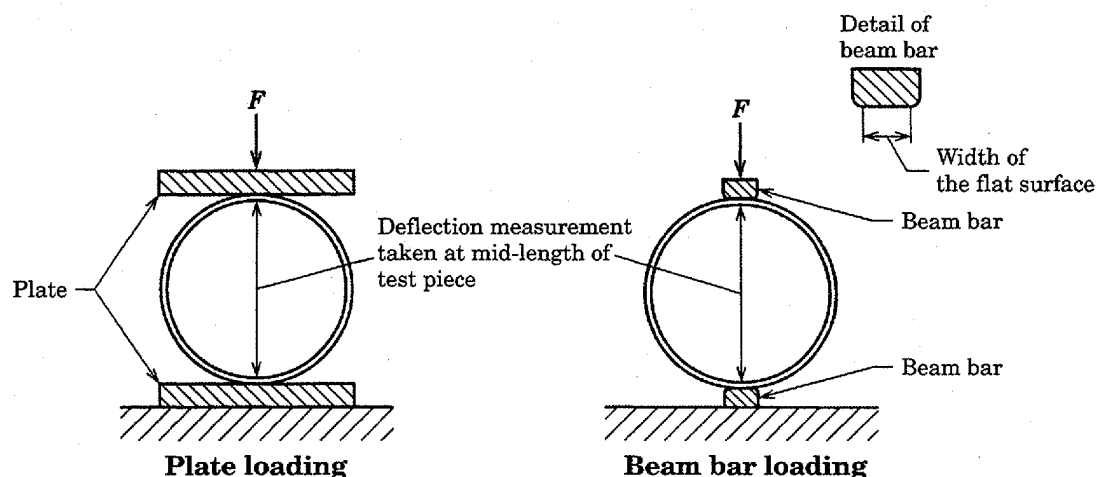
4 Apparatus

4.1 Compressive-loading machine, comprising a system capable of applying, without shock, a compressive force at a controlled rate through two parallel load application surfaces conforming to 4.2 so that a horizontally orientated pipe test piece conforming to clause 5 can be compressed vertically. The accuracy of loading shall be $\pm 1\%$ of the maximum indicated load.

4.2 Load application surfaces

4.2.1 General arrangement The surfaces shall be provided by a pair of plates (see 4.2.2), or a pair of beam bars (see 4.2.3), or a combination of one such plate and one such bar, with their major axes perpendicular to and centred on the direction of application of the load F by the compressive-loading machine, as shown in figure 1. The surfaces in contact with the test piece shall be flat, smooth, clean and parallel. When applying the load using plates in method C a rubber plate of about 10 mm thickness may be put on the surface in contact with the test piece.

Plates and beam bars shall have a length at least equal to that of the test piece (see clause 5) and a thickness such that visible deformation does not occur during the test.



Remarks : In method C, the deflection of the plate may be measured.

Figure 1 Schematic diagram of the test arrangement

4.2.2 Plates The plate(s) shall have a width of at least 100 mm.

4.2.3 Beam bars Each beam bar shall have rounded edges, a flat face (see figure 1) without sharp edges and a width dependent upon the pipe as follows:

- a) for pipes with a nominal size less than DN 300, the width shall be 20 mm $\pm$ 2 mm;
- b) for pipes of nominal sizes DN 300 or greater, the width shall be 50 mm $\pm$ 5 mm.

The beam bars shall be designed and supported such that no other surface of the beam bar structure comes into contact with the test piece during the test.

4.3 Dimension-measuring instruments, capable of determining

- the necessary dimensions (length, diameter, wall thickness) to an accuracy of within $\pm$ 0.1 mm (in the case of method C, the length to an accuracy of within $\pm$ 0.5 mm);
- the deflection of the test piece in the vertical direction to an accuracy of within $\pm$ 1.0 % of the maximum value.

5 Test pieces

5.1 Preparation Each test piece shall be a complete ring cut from the pipe to be tested. The length of the test piece shall be as specified in the referring standard, with permissible deviations of $\pm$ 5 %. Where a referring standard does not exist or does not specify the length of the test piece, the said length shall be 300 mm $\pm$ 15 mm.

The cut ends shall be smooth and perpendicular to the axis of the pipe.

Straight lines, to serve as reference lines, shall be drawn on the inside or the outside along the length of the test piece at 60° intervals in the cases of methods A and B and 180° intervals in the case of method C around its circumference.

5.2 Number The number of test pieces shall be as specified in the referring standard. Where a referring standard does not exist or does not specify the number of test pieces the said number shall be one per pipe size.

5.3 Determination of dimensions

5.3.1 Length Measure the length of the test piece along each reference line to an accuracy of 0.2 mm in methods A and B and ± 1 mm in method C.

Calculate the average length L , in metres, of the test piece from the six measured values in the cases of methods A and B and from the two measured values in the case of method C.

5.3.2 Wall thickness Measure to within ± 0.2 mm the wall thickness of the test piece at each end of each reference line. Calculate the average wall thickness e , in metres, of the 12 measured values in the cases of methods A and B and of the four measured values in the case of method C.

5.3.3 Mean diameter Measure to an accuracy of within ± 0.5 mm either of the following;

- a) the internal diameter d_i of the test piece between each pair of diametrically opposed reference lines at their mid-length, e.g. by means of a pair of calipers;
- b) the external diameter d_e of the test piece at the mid-points of the reference lines, e.g. by means of circumferential-wrap steel tape.

Calculate the mean diameter d_m of the test piece using the values obtained for wall thickness and either the internal or the external diameter (see 2.4).

6 Conditioning Unless otherwise specified by the referring standard, store the test pieces for at least 0.5 h at the test temperature (see 7.1) prior to testing. In cases of dispute, condition the test pieces for 24 h at $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ before testing, or subject them to a mutually agreed conditioning schedule.

7 Procedure

7.1 Test temperature If the temperature is specified in the referring standard, conduct the following procedure at that temperature.

7.2 Positioning of the test piece Place a test piece in the apparatus with a pair of diametrically opposed reference lines in contact with the plate(s) and/or beam bar(s). Ensure that the contact between the test piece and each plate or beam bar is as uniform as possible and that the plate(s) and/or beam bar(s) are not tilted laterally.

7.3 Application of load and measurement of deflection

7.3.1 General Carry out a test in accordance with 7.3.2, 7.3.3 or 7.3.4. In the cases of methods A and B, the test shall be carried out at each pair of reference lines (see 5.1). Allow the test piece to recover between each test. In cases of dispute, allow 15 min between each test.

7.3.2 Method A: Using constant load Apply the compressive load at an approximately constant rate so that a relative deflection between 2.5 % and 3.5 % is reached in $60 \text{ s} \pm 10 \text{ s}$. Keep this load constant for 2 min, and at the end of this period determine and record the load and the deflection.

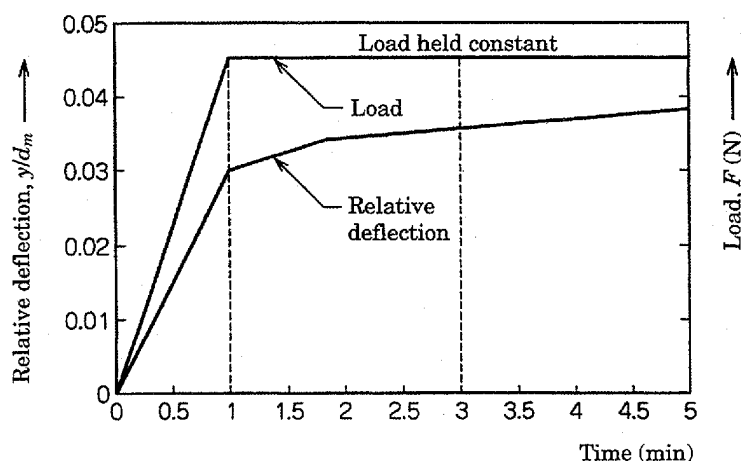


Figure 2 Method A: Load and corresponding deflection versus time

7.3.3 Method B: Using constant deflection Apply the compressive load at an approximately constant rate so that a relative deflection between 2.5 % and 3.5 % is reached in $60 \text{ s} \pm 10 \text{ s}$. Keep this deflection constant for 2 min, and at the end of this period determine and record the deflection and the load.

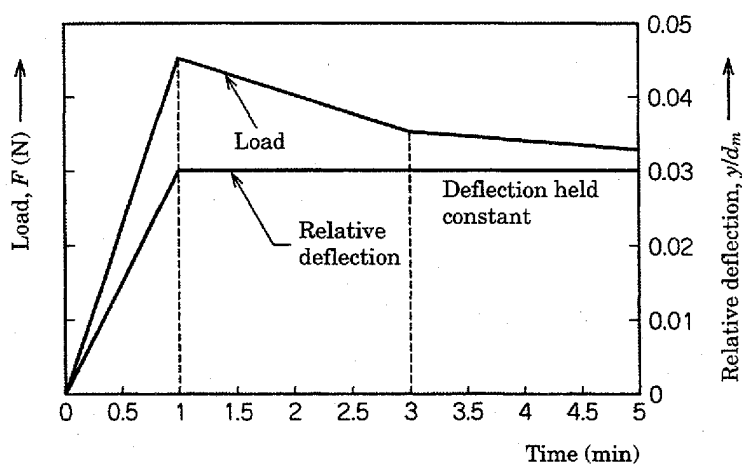


Figure 3 Method B: Deflection and corresponding load versus time

7.3.4 Method C: Case of little time dependency Apply the compressive load by the method specified in the referring standard and measure and record the compressive load at the time of coming to the specified vertical deflection.

8 Calculation Calculate the initial specific ring stiffness S_0 for each of the three positions using the following equation: